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ABSTRACT

As the technological revolution continues, there is an increased emphasis on mathematics and science. Many people feel that there are significant gender differences in both attitudes toward, and achievement in, these subjects. This study examined some of the attitudes toward mathematics and achievement in mathematics as measured by the 1977-78 and 1981-82 National Assessment of Educational Progress (NAEP) Mathematical Assessments. It explored the relationships between them, and between other types of influences, including those of community, school, and home, as well as gender, age and year. Attitudes toward mathematics were measured using a group of 14 statements which were used to construct three specific attitude scales and an overall Math Attitude Index. Achievement was measured using the NAEP percentile scores. Various analyses indicated that parents' education and race of student had the strongest influence and gender the least influence on achievement of the six significant independent variables identified. It is suggested that schools need to develop methods to encourage and help students who have been identified as being members of some of the subpopulations that have negative attitudes and lower achievement scores. (TW)

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Mathematics Attitudes and Achievement:

Gender Differences in a Multivariate Context

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CONTENTS

Abstract ii

page

1. INTRODUCTION 1

The Data 5
Description of Population 11

2. ATTITUDES TOWARD MATHEMATICS 11

Personal Demographics 12
Community and School Demographics 13
The Bivariate Analysis of Math Attitude Items 14
The Log-Linear Analysis of Math Attitudes 15
Personal Demographics and the Math and Oneself Attitude Scale 15
Personal Demographics and the Math and Society Attitude Scale 20
Personal Demographics and the Math as a Discipline Attitude Scale 23
Location Demographics and the Math and Oneself Attitude Scale 27
Location Demographics and the Math and Society Attitude Scale 30
Location Demographics and the Math as a Discipline Attitude Scale 34

3. MATHEMATICS ACHIEVEMENT 37

Main Effects Analysis for Math Achievement 40
Interaction Effects on Math Achievement 40

4. MATH ATTITUDE INDEX 47

Main Effects Analysis for Math Attitude Index 48
Interaction Effects on Math Attitude Index 50

5. SUMMARY 54

REFERENCES 58

Appendix page

A. BIVARIATE DISTRIBUTIONS FOR MATH ATTITUDE ITEMS 61

LIST OF TABLES

Table		page
1.	Source of NAEP Data on Attitudes and Achievment in Mathematics	5
2.	Basic Population Demographics	11
3.	Multivariate Distribution of Math and Oneself Scale Among Personal Demographic Groups	17
4.	Multivariate Model of Math and Oneself Attitude with Personal Demographics	18
5.	Significant Relationships Between Math and Oneself Attitude and Personal Demographics	20
6.	Multivariate Distribution of Math and Society Scale Among Personal Demographic Groups	21
7.	Multivariate Model of Math and Society Attitude with Personal Demographics	22
8.	Significant Relationships Between Math and Society Attitude and Personal Demographics	23
9.	Multivariate Distribution of Math as a Discipline Scale Among Personal Demographic Groups	25
10.	Multivariate Model of Math as a Discipline Attitude with Personal Demographics	26
11.	Significant Relationships Between Math as a Discipline Attitude and Personal Demographics	26
12.	Multivariate Distribution of Math and Oneself Scale Among Location Demographic Groups for Small Schools	28
13.	Multivariate Distribution of Math and Oneself Scale Among Location Demographic Groups for Large Schools	29
14.	Multivariate Model of Math and Oneself Attitude with Location Demographics	30

15. Multivariate Distribution of Math and Society Scale Among Location Demographic Groups for Small Schools 31

16. Multivariate Distribution of Math and Society Scale Among Location Demographic Groups for Large Schools 32

17. Multivariate Model of Math and Society Attitude with Location Demographics 33

18. Significant Relationships Between Math and Society Attitude and Location Demographics 34

19. Multivariate Distribution of Math as a Discipline Scale Among Location Demographic Groups for Small Schools 35

20. Multivariate Distribution of Math as a Discipline Scale Among Location Demographic Groups for Large Schools 36

21. Multivariate Model of Math as a Discipline Attitude with Location Demographics 37

22. Mean Percentile Ranking on Math Achievement for Main Effects 39

23. Main Effects for Analysis of Variance for Math Achievement 40

24. Mean Percentile Ranking on Math Achievement for Significant Interaction Effects 41

25. Interaction Effects for Analysis of Variance for Math Achievement 44

26. Mean Ranking on Math Attitude Index for Main Effects . . 49

27. Main Effects for Analysis of Variance for Math Attitude Index 50

28. Mean Ranking on Math Attitude Index for Significant Interaction Effects 52

29. Interaction Effects for Analysis of Variance for Math Attitude Index 53

1. INTRODUCTION

It is the purpose of this paper to examine some of the attitudes toward mathematics and achievement in mathematics as measured by the 1977-78 and 1981-82 National Assessment of Educational Progress(NAEP) Mathematics Assessments. It will explore the relationships between them, and between other types of influences. These other influences include those of community, school, and home, as well as gender, age and year.

As the technological revolution continues, there is an increased emphasis on mathematics and science. The area of gender differences in these subjects has been explored for many years. Many people feel that there are significant gender differences in both attitudes toward, and achievement in, these subjects.

A contributing factor to these gender differences may be sex-role stereotyping. Previous research has shown that women who anticipate a conflict between a career and the traditional role of homemaking are more likely to opt for the traditional role. Mathematics has long been considered a male domain (Astin, 1974; Rossi, 1965).

In a study of 1,233 high-school students, Fennema and Sherman (1977) concluded that few sex-related cognitive differences existed, but that there are many attitudinal ones. There are important relationships between socio-culturai factors and sex-related cognitive differences. They found little direct evidence that the Attitude Toward Success in Mathematics is an important variable influencing mathematics achievement of high-school girls.

Tobias (1978) feels that "sex differences seem to be lodged in acquired skills not in computation, visualization, and reasoning per se, but in ability to take math problems apart, in willingness to tolerate certain kinds of ambiguity and in careful attention to mathematical detail." (pp.95-96)

National Assessment of Educational Progress reports have confirmed the fact that there are significant gender differences in achievement on mathematics assessments beginning at puberty and continuing through adult life, with males generally having superior scores (NAEP, 1978, 1979).

A path analysis study of females enrolled in advanced placement mathematics courses by Casserly and Rock (no date), showed that "positive attitudes towards women's roles and occupational stereotypes depend on the attitudes and education of the mother, rather than the father" (p. 279). They also found that encouragement from mathematics teachers had a positive effect on females.

A multiple regression study of NAEP data by Welch, Anderson, and Harris (1980) concluded that there was a powerful relationship between the amount of mathematics studied and mathematics learned when they controlled for variations in home and community backgrounds as indicators of mathematics aptitude.

In a summary of previous research findings, Brush (1980) identifies four general types of explanations that have been offered to address the problem of math avoidance among females: lack of ability, negative attitudes toward the subject, perceived

lack of usefulness of math in future life, and a discouraging social milieu.

She concludes from her three-year study of sixth through twelfth graders:

> In sum, research findings and anecdotal evidence suggest that many kinds of conditions may contribute to a general like or dislike of mathematics, that girls then to have a more negative attitude toward mathematics than boys, and that negative attitudes tend to accompany failure to participate in optional or advanced mathematics courses. (p.15)

A followup study by Benbow and Stanley (1982) of their Study of Mathematically Precocious Youth established that the gender differences in mathematical reasoning ability persisted over several years. They also found few significant gender differences in mathematics attitudes. One must remember that this study includes only students who are mathematically gifted and highly motivated, and that it is based on self-reported data. It was their conclusion that in the intellectually, rather homogeneous group studied, mathematical reasoning ability was a better predictor of mathematics achievement than were attitudes toward mathematics.

Pallas and Alexander (1983) concluded in their study of sex differences in quantitative SAT performance that there are not significant gender differences in the background variables of fathers' education, mothers' education, race, and (most notably) ninth grade quantitative test performance. They did find a decided female disadvantage of the end of high school. These data are consistent with the general finding that the sex differences

in quantitative test performance are small to nonexistent at the beginning of high school, but large at the end.

In a study of fourth grade mathematics, Peterson and Fennema (1985) concluded that girls and boys did not differ significantly in mathematics achievement. They did find, however, that activities within the classroom may have different influences on girls' and boys' learning of math.

Parental influence also affects an individual's attitudes and achievement, although the exact nature of the influence is not clear from the research. Another source of influence on attitudes and achievement in mathematics is that from peers, teachers, and counselors at school. Unfortunately, teachers often treat males and females differently in mathematics classes.

The impact of the popular press reports on parents' attitudes toward their children's abilities and performance in mathematics was studied by Jacobs and Eccles (1985). The pattern they discovered was that parents exposed to popular mass media reports about mathematics research appeared to change attitudes slightly more than those not exposed to the mass media reports. Fathers' beliefs about the mathematical ability of their children and their stereotypes about gender differences in ability became more similar for males and females. On the other hand, mothers who were exposed became more differentiated on their beliefs and stereotypes, depending on the gender of the child. Mothers of females became much more conscious of gender differences after hearing the research findings.

A report on participation and achievement of women in mathematics by Armstrong (1985), opens with the following statement:

> It is generally accepted that elementary school girls excel in arithmetic and science. However, the picture begins to change in junior high school as boys overtake and pass their female contemporaries in mathematics achievement. From the eighth grade on, female participation in mathematics declines steadily until, by high school graduation, male students outnumber women in mathematics classes. (pp. 59-60)

An individual's attitude toward mathematics is a combination of that individual's enjoyment, confidence, and anxiety toward mathematics (Armstrong, 1985).

THE DATA

The population in this study consisted of 13-year-old and 17-year-old students assessed by the National Assessment of Educational Progress (NAEP) as part of the 1977-78 and 1981-82 mathematics assessments. It was a national probability sample of 8,002 students. The distribution within each age group and assessment year is shown in Table 1.

TABLE 1

Source of NAEP Data on Attitudes and Achievment in Mathematics

Year	Age	N
1977-78	13-year-olds	2,050
	17-year-olds	2,129
1981-82	13-year olds	1,844
	17-year-olds	1,979
Total		8,002

Since the first assessment in 1969-70, the National Assessment of Educational Progress (NAEP) has collected one of the most extensive data sets in the history of educational research. It provides a national probability survey of knowledge, skills, understanding, and attitudes of three age levels 9-, 13-, and 17-year-olds in 10 different subject areas along with a wide variety of demographic information. From the point of view of the analyst, most of the individual items are of little interest per se, but are of interest when they are combined into scales and indices that represent broader constructs important to various analytic questions.

The idea of a national assessment began in the early 1960s with the thoughts of Francis Keppel, John Gardner, and others, as they speculated about the needs of education in this country and the criticisms that were being leveled against it.

Accurate information about what and how children are learning is essential for wise decision-making in education. However, information alone does not change education. What is needed is wise use of this information by those who can change education.

NAEP is an ongoing project whose ultimate goal is the measurement of change in knowledge, skills, understandings, and attitudes related to educational experiences and objectives and, therefore, requires repeated measurements.

NAEP uses a deeply stratified three-stage national probability sample design with oversampling of low-income and rural areas. Primary sampling units are counties or groups of counties

meeting minimum size requirements. These are stratified by region and size of community. Public and private schools are randomly selected in the second stage of sampling, and individuals are randomly selected in the third stage. The selection probability of each individual is computed and its reciprocal, adjusted for non-response, is used to weight each response in all statistical calculations.

The development of an assessment in a learning area evolves from a consensus process that takes several years of work by educators, measurement specialists, and lay persons from all over the nation (Wright, Larsson, & Ramlow, 1981). The process begins with the development of objectives for the learning area. These objectives state the general goals it is felt young people should achieve in the course of their education. The objectives are then reviewed by the subject matter specialists, the measurement experts, and the lay people, and revised as necessary. When completed they are given to writers whose task is to create exercises appropriate to measure the objectives.

The exercises are then divided into booklets for administration. The average booklet takes approximately 45 minutes to complete. Each is given to deeply stratified multistage probability samples of the appropriate age group, 9, 13, or 17-year-olds. Open-ended exercises are scored by hand, while multiple-choice and true-false exercises are machine scored. The higher-level data on school and community information are then added to each respondent record, using common labels for background and demo-

graphic variables that extend across assessment years (Wright, Larsson, & Ramlow, 1981).

After consistency checks, the data are then stored in complex hierarchical files along with corresponding documentation. Both data and documentation are compatible with major statistical booklets such as Statistical Analysis Systems (SAS) and Statistical Packages for the Social Sciences (SPSS). All data files are rectangular and numeric with uniform codes for "I don't know," "no response," and "missing value." These machine-readable data and documentation are then made available for public use (Wright, Larsson, & Ramlow, 1981).

Shortly after the beginning of NAEP assessments, VonHaden and King (1971) discussed some of the implications of a national assessment. It was their opinion that, while a national assessment will not cure many of the educational ills, it will be a valuable tool to aid education in solving some of its perplexing problems. One of the strengths of NAEP data are that they reveal what individual students have learned as well as what various groups (regions, socioeconomic groups, types of communities, gender, age, etc.) have learned. NAEP assessments also will provide information for comparing progress in education over a period of years.

Mosteller and Moynihan (1972), in an article appearing in a volume dealing with reanalysis of Coleman's Equality of Educational Opportunity Study, stated:

> At regular intervals the nation should measure the state of the schools, its students and teachers, with a view to appraising progress toward its goals . . . The

> National Assessment of Educational Progress of the Educational Commission of the States gives us the first appraisal of what this country's school children and young adults know and can do. (p. 55)

It was their opinion that as reassessments took place it would be possible to analyze the changes in amounts and kinds of knowledges, skills, understandings, and attitudes.

In the same volume, Dyer (1972) noted that the sampling plan of NAEP deliberately avoids the possibility of providing descriptive indices for state and local school systems, but instead provides a set of educational indices for the nation as a whole and for various combinations of subgroups at each age level. From these data it might be possible to develop some indices to discern trends in pupil performance, and this is a problem for future analysts. The groundwork for further in-depth analyses has been laid.

NAEP can help provide answers on how to measure equality of educational opportunity by providing not only information on what young people do and do not know in each subject area, but also sociological information which will allow comparisons of young people from various subgroups. It can provide valuable benchmarks against which future educational change can be measured (Forbes, 1976).

NAEP data provide a powerful source for secondary analysis, although secondary analysis is more complex and demanding than it often appears to the uninitiated. From the perspective of the analyst, the most difficult problem is not the structure of the data or its volume, but the structure of the documentation (Anderson, Welch, & Harris, 1980).

However, many of these problems have been alleviated by work done at the Public Opinion Laboratory at Northern Illinois University. The staff there has developed a system of simplifying the documentation and merging the individual booklet data files for secondary analysis (McConeghy & Miller, 1983).

During the past decade and a half, the various revelations of NAEP assessments have helped to make education more "newsworthy" (Bailey, 1981). The assessment programs of NAEP now make it possible for national comparisons to be made over time (Chall, 1983).

Because of the types of background information collected it is possible to do correlational studies relating home, community, school, and individual respondent characteristics to the achievement of specific objectives. The earlier data collected by NAEP did not provide as much background information as was needed to do effective studies of this kind. However, beginning with the 1975-76 assessment, this aspect has been strengthened to allow more in-depth analyses. Secondary analyses of NAEP data are becoming more prevalent as documentation is improved and background variables become standardized. These improvements, coupled with the advances made in multivariate categorical data analysis, make NAEP data an excellent source of meaningful, large-scale, national probability multivariate analyses that can determine existing relationships and provide a sound basis for the improvement of teacher training and inservice training of existing teachers.

DESCRIPTION OF POPULATION

This analysis included a total of 8,002 students. The group was almost evenly divided between males and females (see Table 2). There were slightly more students assessed in 1977-78 than in 1981-82. The age groups were also almost evenly distributed.

TABLE 2

Basic Population Demographics

Group	%	N
Gender		
Male	49%	3,936
Female	51	4,066
Assessment Year		
1977-78	52	4,179
1981-82	48	3,823
Age		
13-year-olds	49	3,895
17-year-olds	51	4,107

2. ATTITUDES TOWARD MATHEMATICS

There were 14 statements included in the math attitude question in the assessments. Each respondent was asked to indicate his or her level of agreement with each of the following statements about math:

A. I am good at mathematics.

B. Math helps a person think logically.

C. It is important to know math to get a good job.

D. It is important to know arithmetic to get a good job.

E. I am taking math because I have to.

F. New discoveries are seldom made in math.

G. Mathematics is more for boys than girls.

H. I would like to take more mathematics.

I. Creative people have trouble with math.

J. Estimating is an important math skill.

K. I understand what we talk about in math.

L. Trial and error can often be used to solve math problems.

M. A good grade in math is important to me.

N. Justifying math statements is important.

The response options were: strongly disagree, disagree, undecided, agree, or strongly agree. There was less than one percent non-response on each of these items.

For the purposes of this analysis the responses for strongly agree and agree were combined as were the responses for strongly disagree and disagree. Some of the items also had the responses recoded in the opposite direction to allow later creation of additive scales for components within the battery of 14 items, plus an overall additive scale indicating a combined Math Attitude Index.

PERSONAL DEMOGRAPHICS

The race classification used was a standard NAEP classification with the categories of white, black, and other. Parents' education was based on the highest education completed by at least one parent. It was dichotomized into those who had a high school diploma or less and those who had some post-high-school education.

COMMUNITY AND SCHOOL DEMOGRAPHICS

The first classification of communities was by location. Three categories were used. The first was big cities, the second was suburban areas of big cities, and the third was a residual category that included all other communities.

Communities were also classified according to the type of occupations reported in the Principal's Questionnaire. Each principal was asked to indicate what proportion of the community was employed in professional, skilled trades, unskilled labor, or farm occupations, along with the proportion who were unemployed or on welfare. The total of these six categories for each community was 100%.

Those communities with over 50% employment in professional occupations were classified as "mainly professional." Those with over 50% in skilled trades were classified as "mainly skilled labor." Those with over 50% in unskilled labor occupations were classified as "mainly unskilled labor." Those with over 50% in farm occupations were classified as "mainly farming." Those with over 50% unemployed were classified as "mainly unemployed." Those with over 50% on welfare were classified as "mainly welfare." The remaining were classified as "mixed."

This "mixed" category was then further divided. If the proportion of professional and skilled workers was over 50%, the community was classified as "professional-skilled." If the proportion of unemployed and welfare was over 50%, the community was classified as "unemployed-welfare." If the proportion of uns-

killed workers and farm occupations was over 50%, the community was classified as "unskilled-farm." All others remained classified as "mixed." The "unemployed-welfare" classification and the "unskilled-farm" classification were then combined for this analysis to give a total of three types of communities: those that have no predominant category, those in which over 50% of the people are employed in professional or skilled occupations, and those in which over 50% of the people are unemployed or on welfare, or in which over 50% were employed in unskilled or farm occupations.

The size of school was categorized after examination of the total enrollment reported by the principal of each school. Schools with an enrollment of less than 900 were classified as small. Those with 900 or more students were classified as large.

Schools were also classified according to the racial composition of the school, using information provided on the Principal's Questionnaire. Principals were asked to indicate what proportion of the student body was white. The categories used were: 39% or less, 40% to 69%, and 70% and over. These categories were named mostly nonwhite, mixed, and mostly white, respectively.

THE BIVARIATE ANALYSIS OF MATH ATTITUDE ITEMS

A traditional bivariate crosstabulation analysis was done on each of the 14 items using the following personal demographics as independent variables: sex, age, race, and parents' education. A second bivariate crosstabulation analysis was done using the

following community and school characteristics as independent variables: location of community, type of community, size of school, and racial balance of the school.

The majority of these statements showed statistically significant differences in responses to most of the above statements. The responses for each subpopulation group on each statement are included in table form in the Appendix.

THE LOG-LINEAR ANALYSIS OF MATH ATTITUDES

The next step was to examine these differences in a multivariate context, as individual respondents reflect combinations of independent variables. The examination of multivariate distributions also allowed the examination of any interaction effects.

Personal Demographics and the Math and Oneself Attitude Scale

Using the documentation supplied by NAEP, the 14 statements were combined into three scales. The first one included the following statements:

A. I am good at mathematics.

E. I am taking math because I have to.

H. I would like to take more mathematics.

K. I understand what we talk about in math.

M. A good grade in math is important to me.

It was titled the Math and Oneself Scale(MOAS) and ranged in value from 0 to 25. It was dichotomized into a positive and neg-

ative category. The multivariate distribution on the MOAS among the personal demographic variables is shown in Table 3.

A multivariate logit analysis was then done using Math and Oneself Scale as the dependent variable and age, gender, race, and parents' education as the independent variables. The results of this analysis are shown in Table 4.

For those not familiar with Goodman's (1972a, 1972b) log-linear technique, model H1 is referred to as the independence model. It provides an estimate of the total mutual dependence in the model, that is, the total error in a proportional-reduction-of-error sense. The Likelihood Ratio chi-square (L.R.X^2) is utilized as a measure rather than the Pearson chi-square because the former is additive while the latter is not. The Coefficient of Multiple-Partial Determination (CMPD) is a measure of the proportional-reduction-of-error and is roughly analogous to the multiple R^2 in quantitative regression models.

Model H2 in Table 4 is referred to as the main effects model and it provides an estimate of the improvement in prediction based on the direct effect of each of the independent variables on the dependent variable. By deleting each of these main effects one at a time, it is possible to determine the relative contribution of each main effect. For example, Model H3 is the same as Model H2 except that the OA term (the direct effect of age on the MOAS) has been deleted. Thus, it is possible to determine by subtraction, that age accounted for 52% of the mutual dependence in the model, and was the strongest main effect (see

TABLE 3

Multivariate Distribution of Math and Oneself Scale Among Personal Demographic Groups

Parents' Education	Race	Age	Gender	Math and Oneself Scale: Negative	Positive	N
HS & less	White	13	Male	49.7%	50.3%	801
			Female	54.2	45.8	731
		17	Male	63.4	36.6	722
			Female	67.2	32.8	856
	Black	13	Male	39.3	60.7	117
			Female	37.7	62.3	138
		17	Male	61.0	39.0	141
			Female	54.1	45.9	157
	Other	13	Male	55.1	44.9	69
			Female	61.2	38.8	98
		17	Male	65.1	34.9	86
			Female	69.2	30.8	78
Post H.S.	White	13	Male	41.5	58.5	829
			Female	44.5	55.5	820
		17	Male	49.7	50.3	900
			Female	62.6	37.4	916
	Black	13	Male	36.2	63.7	80
			Female	40.4	59.6	99
		17	Male	52.6	47.4	76
			Female	51.8	48.2	85
	Other	13	Male	34.8	65.2	69
			Female	41.9	58.1	43
		17	Male	52.3	47.7	44
			Female	46.8	53.2	47

TABLE 4

Multivariate Model of Math and Oneself Attitude with Personal Demographics

Model	Terms	d.f.	L.R.X^2	CMPD
H1	GARP,O.	23	230.77	--
H2	GARP,OA,OP,OG,OR.	18	30.04	.893
H3	Difference due to OA.	1	145.88	.520
H4	Difference due to OP.	1	65.59	.234
H5	Difference due to OG.	1	22.55	.080
H6	Difference due to OR.	2	22.38	.080
H7	Difference due to ORP.	2	8.35	.030
H8	GARP,OA,OP.	21	74.07	.736

Legend:
O = Math and Oneself Attitude.
A = Age.
P = Parents' education.
G = Gender.
R = Race.
d.f. = Degrees of Freedom.
L.R.X^2 = Likelihood-Ratio Chi-Square.
CMPD = Coefficient of Multiple-Partial Determination.

Table 4). The other significant term in the model was the OP term, or the effect of parents' education, which accounted for an additional 23% of the variation.

Since of the the goals of log-linear analysis is parsimony, the object is to see how much can be left out of the model and still give a reasonable improvement on the prediction of the dependent variable. The inclusion of all terms that make a statistically significant contribution to the prediction is generally the rule. However, with the large number of cases in this analysis, many of the terms made a statistically significant contribution. The inclusion of all these terms usually resulted in a fi-

nal model which accounted for almost all of the variation, because it included all of the terms. The decision was then made to include only those terms which accounted for the largest amount of variation in the final model. This, by the way, was not true for the second set of analyses of the math attitude scales and location demographics.

For the MOAS the following terms were included in the final model: the direct effect of age and the direct effect of parents' education. There were no significant interactions identified for this model. The final model accounted for almost 74% of the variation and provided a good fit for the data. What this means in practical terms is that if the age and parents' education are known, then the classification on the MOAS can be accurately predicted almost 74% of the time. This is a considerable improvement on chance alone.

Next, the standardized values (S.V.) of Goodman's lambda were examined to determine the direction of these effects in the final model. They are shown in Table 5. These standardized values have the same interpretation as a z-score and are significant at the .05 level with a value of 1.96 or greater.

Examination of the standardized values showed that 13-year-olds were more likely to have a positive attitude on the MOAS as were those students who came from homes where at least one parent had some post-high-school education.

TABLE 5

Significant Relationships Between Math and Oneself Attitude and Personal Demographics

		Math and Oneself Attitude			
		Positive		Negative	
Predictors	N	%	S.V.	%	S.V.
Age					
13-year-olds	3894	54%	12.10	46%	-12.04
17-year-olds	4108	40	-12.04	60	12.04
Parents' Education					
H.S. or less	3994	42	-7.79	58	7.79
Post H.S.	4008	51	7.79	49	-7.79

Personal Demographics and the Math and Society Attitude Scale

The next scale created was one that included the following items:

C. It is important to know math to get a good job.

D. It is important to know arithmetic to get a good job.

This scale was named the Math and Society Scale(MSAS). The range of values went from 0 to 10. The scale was dichotomized into a positive and a negative category. The multivariate distribution is shown in Table 6.

The logit analysis results are shown in Table 7. The direct effect of age accounted for 76% of the variation in the model (see Model H2 in Table 7). The other significant direct effect was that of race, which accounted for an additional 9% of the variation. There was one significant interaction identified, that of age and race. The final model included the effect of

TABLE 6

Multivariate Distribution of Math and Society Scale Among Personal Demographic Groups

Parents' Education	Race	Age	Gender	Math and Society Scale: Negative	Math and Society Scale: Positive	N
HS & less	White	13	Male	39.0%	61.0%	801
			Female	36.3	63.7	731
		17	Male	58.5	41.5	723
			Female	63.4	36.6	856
	Black	13	Male	30.8	69.2	117
			Female	34.8	65.2	138
		17	Male	43.7	56.3	142
			Female	42.9	57.1	156
	Other	13	Male	40.6	59.4	69
			Female	34.7	65.3	98
		17	Male	53.5	46.5	86
			Female	41.0	59.0	78
Post H.S.	White	13	Male	36.6	63.4	829
			Female	34.9	65.1	819
		17	Male	50.7	49.3	899
			Female	60.0	40.0	916
	Black	13	Male	42.5	57.5	80
			Female	29.6	70.4	98
		17	Male	40.8	59.2	76
			Female	40.5	59.5	84
	Other	13	Male	36.2	63.8	69
			Female	40.9	59.1	44
		17	Male	43.2	56.8	44
			Female	48.9	51.1	47

age, the effect of race, and the interaction effect of age and race. It accounted for slightly over 89% of the variation in the model and provided an excellent fit.

TABLE 7

Multivariate Model of Math and Society Attitude with Personal Demographics

Model	Terms	d.f.	L.R.X^2	CMPD
H1	GARP,S.	23	390.54	--
H2	GARP,SA,SR,SP,SG.	18	39.03	.874
H3	Difference due to SA.	1	297.36	.761
H4	Difference due to SR.	2	35.30	.090
H5	Difference due to SP.	1	7.91	.020
H6	Difference due to SG.	1	3.08	.008
H7	Difference due to SAR.	2	18.20	.047
H8	GARP,SA,SR,SAR.	18	42.33	.892

Legend:
S = Math and Society Attitude.
A = Age.
R = Race.
P = Parents' education.
G = Gender.
d.f. = Degrees of Freedom.
L.R.X^2 = Likelihood-Ratio Chi-Square.
CMPD = Coefficient of Multiple-Partial Determination.

Examination of the standardized values for this model shows that 13-year-olds were more likely to have a positive attitude on the MSAS. Black students were more likely than whites or others to have a positive attitude. The interaction between age and race showed that among the white students, the younger ones were more likely to have a positive attitude. There were no differences among the other racial classifications and age combinations (see Table 8).

TABLE 8

Significant Relationships Between Math and Society Attitude and Personal Demographics

			Math and Society Attitude			
			Positive		Negative	
Predictors		N	%	S.V.	%	S.V.
Age						
13-year-olds		3893	64%	7.07	36%	-7.07
17-year-olds		4107	44	-7.07	56	7.07
Race						
White		6574	52	-4.68	48	4.68
Black		891	61	3.30	51	-3.30
Other		535	60	n.s.	40	n.s.
Race	Age					
White	13	3180	63	4.11	37	-4.11
	17	3394	42	-4.11	58	4.11
Black	13	433	66	n.s.	34	n.s.
	17	458	58	n.s.	42	n.s.
Other	13	280	63	n.s.	37	n.s.
	17	255	53	n.s.	47	n.s.

Personal Demographics and the Math as a Discipline Attitude Scale

The third attitude scale constructed was one that indicated the student's attitude toward mathematics as a discipline. It was titled the Math as a Discipline Attitude Scale(MDAS). It included the following items:

B. Math helps a person think logically.

F. New discoveries are seldom made in math.

G. Mathematics is more for boys than girls.

I. Creative people have trouble with math.

J. Estimating is an important math skill.

L. Trial and error can often be used to solve math problems.

N. Justifying math statements is important.

The range of values for this scale was from 0 to 35. It also was dichotomized into a positive and negative category. The multivariate distribution among the personal demographic groups is shown in Table 9.

The logit analysis showed that there were two significant direct effects. Both age and parents' education added significant information about the model. Age accounted for over 46% of the variation in the model, while level of parents' education accounted for almost an additional 34% of the variation. There were no significant interaction terms identified. The final model, then, included the direct effect of age and parents' education and accounted for over 82% of the variation, an excellent fit to the data (see Table 10).

The standardized values for this analysis are shown in Table 11. The older students were more likely than the younger ones to have a positive attitude on this scale. Students who had at least one parent with some post-high-school education were also more likely to have a positive attitude on this scale.

TABLE 9

Multivariate Distribution of Math as a Discipline Scale Among Personal Demographic Groups

Parents' Education	Race	Age	Gender	Math as a Discipline Scale: Negative	Positive	N
HS & less	White	13	Male	49.7%	50.3%	801
			Female	54.2	45.8	731
		17	Male	63.4	36.6	722
			Female	67.2	32.8	856
	Black	13	Male	39.3	60.7	117
			Female	37.7	62.3	138
		17	Male	61.0	39.0	141
			Female	54.1	45.9	157
	Other	13	Male	55.1	44.9	69
			Female	61.2	38.8	98
		17	Male	65.1	34.9	86
			Female	69.2	30.8	78
Post H.S.	White	13	Male	41.5	58.5	829
			Female	44.5	55.5	820
		17	Male	49.7	50.3	900
			Female	62.6	37.4	916
	Black	13	Male	36.2	63.7	80
			Female	40.4	59.6	99
		17	Male	52.6	47.4	76
			Female	51.8	48.2	85
	Other	13	Male	34.8	65.2	69
			Female	41.9	58.1	43
		17	Male	52.3	47.7	44
			Female	46.8	53.2	47

TABLE 10

Multivariate Model of Math as a Discipline Attitude with Personal Demographics

Model	Terms	d.f.	L.R.X^2	CMPD
H1	GARP,D.	23	130.97	--
H2	GARP,DA,DP,DR,DG.	18	19.35	.852
H3	Difference due to DA.	1	60.48	.462
H4	Difference due to DP.	1	644.21	.338
H5	Difference due to DR.	2	2.60	.020
H6	Difference due to DG.	1	0.94	.007
H7	GARP,DA.DP.	21	22.86	.825

Legend:
D = Math as a Discipline Attitude.
A = Age.
P = Parents' education.
G = Gender.
R = Race.
d.f. = Degrees of Freedom.
L.R.X^2 = Likelihood-Ratio Chi-Square.
CMPD = Coefficient of Multiple-Partial Determination.

TABLE 11

Significant Relationships Between Math as a Discipline Attitude and Personal Demographics

		Math as a Discipline Attitude			
		Positive		Negative	
Predictors	N	%	S.V.	%	S.V.
Age					
13-year-olds	3893	43%	-7.80	57	7.80
17-year-olds	4106	52	7.80	48	-7.80
Parents' Education					
HS & less	3993	44	-6.84	56	6.84
Post H.S.	4006	51	6.84	49	-6.84

Location Demographics and the Math and Oneself Attitude Scale

The next step in the analysis was to examine the effects of the location demographic variable previously described. The multivariate distribution among these location demographics on the MOAS is shown in Table 12 & Table 13. Note that there are some empty cells in the table and the log-linear analysis was adjusted to compensate for these known empty cells.

The log-linear analysis for this group of variables failed to identify a significant model. Even the main effects model which included all the terms was able to only account for only slightly over 34% of the variation in the model. The conclusion is made that knowledge of these types of variables is not helpful in prediciting the attitude of the student on the MOAS.

TABLE 12

Multivariate Distribution of Math and Oneself Scale Among Location Demographic Groups for Small Schools

Size of School	School Racial Balance	Occup. Typo.	Community Location	Math and Oneself Scale: Negative	Positive	N
Small	Non-white	Mixed	Big City	40.0	60.0	60
			Suburb	20.0	80.0	10
			Other	75.0	25.0	12
		ProfSkil	Big City	28.6	71.4	14
			Suburb	0.0 *	0.0	0
			Other	75.0	25.0	4
		Other	Big City	26.3	73.7	19
			Suburb	72.2	27.8	18
			Other	52.0	48.0	123
	Mixed	Mixed	Big City	43.6	56.4	39
			Suburb	62.5	37.5	32
			Other	48.2	51.8	228
		ProfSkil	Big City	59.1	40.9	66
			Suburb	56.8	43.2	44
			Other	44.4	55.6	81
		Other	Big City	33.3	66.7	3
			Suburb	0.0 *	0.0	0
			Other	49.6	50.4	121
	White	Mixed	Big City	57.1	42.9	91
			Suburb	62.0	38.0	71
			Other	50.4	49.6	706
		ProfSkil	Big City	52.1	47.9	340
			Suburb	49.1	50.9	485
			Other	47.4	52.6	422
		Other	Big City	72.0	28.0	25
			Suburb	46.7	53.3	75
			Other	55.7	44.3	875

TABLE 13

Multivariate Distribution of Math and Oneself Scale Among Location Demographic Groups for Large Schools

Size of School	School Racial Balance	Occup. Typo.	Community Location	Math and Oneself Scale: Negative	Positive	N
Large	Non-white	Mixed	Big City	46.7	53.3	75
			Suburb	0.0 *	0.0	0
			Other	50.0	50.0	10
		ProfSkil	Big City	46.7	53.3	30
			Suburb	45.2	54.8	31
			Other	64.3	35.7	14
		Other	Big City	50.4	49.6	115
			Suburb	63.3	36.7	49
			Other	0.0 *	0.0	0
	Mixed	Mixed	Big City	39.2	60.8	125
			Suburb	47.0	53.0	134
			Other	44.5	55.5	218
		ProfSkil	Big City	43.9	56.1	123
			Suburb	57.5	42.5	40
			Other	0.0 *	0.0	0
		Other	Big City	51.9	48.1	54
			Suburb	59.3	40.7	27
			Other	68.1	31.9	119
	White	Mixed	Big City	64.6	35.4	65
			Suburb	55.9	44.1	136
			Other	55.3	44.7	318
		ProfSkil	Big City	55.7	44.3	494
			Suburb	59.0	41.0	1030
			Other	64.2	35.8	254
		Other	Big City	54.2	45.8	107
			Suburb	56.7	43.3	157
			Other	55.1	44.9	316

TABLE 14

Multivariate Model of Math and Oneself Attitude with Location Demographics

Model	Terms	d.f.	L.R.X^2	CMPD
H1	CTRS,O.	48	125.81	--
H2	CTRS,OS,OR,OT,OC.	41	82.48	.344
H3	Difference due to OS.	1	14.44	.115
H4	Difference due to OR.	2	13.24	.105
H5	Difference due to OT.	2	8.19	.065
H6	Difference due to OC.	2	2.78	.022

Legend:
O = Math and Oneself Attitude.
S = Size of school.
R = School racial balance.
T = Occupational typology of community.
C = Community location.
d.f. = Degrees of Freedom.
L.R.X^2 = Likelihood-Ratio Chi-Square.
CMPD = Coefficient of Multiple-Partial Determination.

Location Demographics and the Math and Society Attitude Scale

The multivariate distribution of the location demographics on the MSAS is shown in Table 15 & Table 16. Again, note the same empty cells as on the previous location demographics analysis.

The log-linear analysis identified two significant direct effects and one significant interaction effect. Both the size of the school and the racial balance of the school made direct contributions to the model. There was also a significant interaction among these two variables (see Table 17). The inclusion of these terms in the final model resulted in one which accounted for over 68% of the variation in the model and provided a reasonably good fit for the data.

TABLE 15

Multivariate Distribution of Math and Society Scale Among Location Demographic Groups for Small Schools

Size of School	School Racial Balance	Occup. Typo.	Community Location	Math and Oneself Scale: Negative	Positive	N
Small	Non-white	Mixed	Big City	42.4	57.6	59
			Suburb	33.3	66.7	9
			Other	27.3	72.7	11
		ProfSkil	Big City	21.4	78.6	14
			Suburb	0.0 *	0.0	0
			Other	50.0	50.0	4
		Other	Big City	40.0	60.0	20
			Suburb	47.1	52.9	17
			Other	41.5	58.5	123
	Mixed	Mixed	Big City	28.2	71.8	39
			Suburb	48.4	51.6	31
			Other	39.0	61.0	228
		ProfSkil	Big City	41.8	58.2	67
			Suburb	33.3	66.7	45
			Other	42.7	57.3	82
		Other	Big City	33.3	66.7	3
			Suburb	0.0 *	0.0	0
			Other	48.3	51.7	120
	White	Mixed	Big City	41.8	58.2	91
			Suburb	50.0	50.0	70
			Other	37.3	62.7	706
		ProfSkil	Big City	40.9	59.1	340
			Suburb	42.9	57.1	485
			Other	38.6	61.4	422
		Other	Big City	42.3	57.7	26
			Suburb	46.7	53.3	75
			Other	44.5	55.5	874

TABLE 16

Multivariate Distribution of Math and Society Scale Among Location Demographic Groups for Large Schools

Size of School	School Racial Balance	Occup. Typo.	Community Location	Math and Oneself Scale: Negative	Positive	N
Large	Non-white	Mixed	Big City	36.5	63.5	74
			Suburb	0.0 *	0.0	0
			Other	30.0	70.0	10
		ProfSkil	Big City	25.8	74.2	31
			Suburb	38.7	61.3	31
			Other	42.9	57.1	14
		Other	Big City	35.7	64.3	115
			Suburb	26.0	74.0	50
			Other	0.0 *	0.0	0
	Mixed	Mixed	Big City	44.4	55.6	124
			Suburb	48.1	51.9	133
			Other	42.7	57.3	218
		ProfSkil	Big City	45.2	54.8	124
			Suburb	56.1	43.9	41
			Other	0.0 *	0.0	0
		Other	Big City	31.5	68.5	54
			Suburb	44.4	55.6	27
			Other	57.1	42.9	119
	White	Mixed	Big City	75.8	24.2	66
			Suburb	56.6	43.4	136
			Other	53.8	46.2	318
		ProfSkil	Big City	50.7	49.3	493
			Suburb	55.6	44.4	1030
			Other	59.3	40.7	253
		Other	Big City	46.7	53.3	107
			Suburb	53.5	46.5	157
			Other	51.6	48.4	316

TABLE 17

Multivariate Model of Math and Society Attitude with Location Demographics

Model	Terms	d.f.	L.R.X^2	CMPD
H1	CTRZ,S.	48	201.02	--
H2	CTRZ,SZ,SR,SC,ST.	41	79.50	.605
H3	Difference due to SZ.	1	72.08	.359
H4	Difference due to SR.	2	26.38	.131
H5	Difference due to SC.	2	5.69	.028
H6	Difference due to ST.	2	2.20	.011
H7	Difference due to SRZ.	2	22.27	.111
H8	CTRZ,SZ,SR,SRZ.	43	63.57	.684

Legend:
S = Math and Society Attitude.
C = Community location.
T = Occupational typology of community.
R = School racial balance.
Z = Size of school.
d.f. = Degrees of Freedom.
L.R.X^2 = Likelihood-Ratio Chi-Square.
CMPD = Coefficient of Multiple-Partial Determination.

The standardized values for the analysis are shown in Table 18. The direct effect of size of school shows that students from smaller schools are more likely to have a positive attitude on the MSAS. The direct effect of the racial balance of the school shows that those who attend schools that are predominantly white are more likely to have a negative attitude on the MSAS. The interaction effect shows that students who attend a small school that is predominantly white are more likely to have a positive attitude while those who attend a large school that is predominantly white are more likely to have a negative attitude on the MSAS. Students attending schools that are predominantly non-

white are most likely to have a positive attitude if it is a large school.

TABLE 18

Significant Relationships Between Math and Society Attitude and Location Demographics

			Math and Society Attitude			
			Positive		Negative	
Predictors		N	%	S.V.	%	S.V.
Size of School						
Small		3961	59%	2.53	41%	-2.53
Large		4041	49	-2.53	51	2.53
School Racial Balance						
Non-white		582	63	3.92	37	-3.92
Mixed		1455	56	n.s.	44	n.s.
White		5965	52	-5.43	48	5.43
School Size	School Race					
Small	Non-white	257	60	-3.50	40	3.50
	Mixed	615	59	n.s.	61	n.s.
	White	3089	59	4.88	41	-4.88
Large	Non-white	325	66	3.50	44	-3.50
	Mixed	840	54	n.s.	46	n.s.
	White	2876	46	-4.88	54	4.88

Location Demographics and the Math as a Discipline Attitude Scale

The multivariate distribution among the location demographic subpopulation groups is shown in Table 19 & Table 20.

The log-linear analysis of this scale and the location demographic groups failed to identify any kind of significant model. Just as with the MOAS, it can be concluded that information of this sort does not help in predicting the student's classification on the MDAS scale (see Table 21).

TABLE 19

Multivariate Distribution of Math as a Discipline Scale Among Location Demographic Groups for Small Schools

Size of School	School Racial Balance	Occup. Typo.	Community Location	Math as a Discipline Scale: Negative	Positive	N
Small	Non-white	Mixed	Big City	61.0	39.0	59
			Suburb	55.6	44.4	9
			Other	45.5	54.5	11
		ProfSkil	Big City	57.1	42.9	14
			Suburb	0.0 *	0.0	0
			Other	75.0	25.0	4
		Other	Big City	52.6	47.4	19
			Suburb	47.1	52.9	17
			Other	60.2	39.8	123
	Mixed	Mixed	Big City	56.4	43.6	39
			Suburb	51.6	48.4	31
			Other	55.0	45.0	229
		ProfSkil	Big City	56.1	43.9	66
			Suburb	45.5	54.5	44
			Other	54.9	45.1	82
		Other	Big City	66.7	33.3	3
			Suburb	0.0 *	0.0	0
			Other	55.0	45.0	120
	White	Mixed	Big City	52.7	47.3	91
			Suburb	65.7	34.3	70
			Other	57.1	42.9	706
		ProfSkil	Big City	51.2	48.8	340
			Suburb	57.3	42.7	485
			Other	49.5	50.5	422
		Other	Big City	50.0	50.0	26
			Suburb	61.3	38.7	75
			Other	52.7	47.3	874

TABLE 20

Multivariate Distribution of Math as a Discipline Scale Among Location Demographic Groups for Large Schools

Size of School	School Racial Balance	Occup. Typo.	Community Location	Math as a Discipline Scale: Negative	Positive	N
Large	Non-white	Mixed	Big City	48.6	51.4	74
			Suburb	0.0 *	0.0	0
			Other	70.0	30.0	10
		ProfSkil	Big City	58.1	41.9	31
			Suburb	38.7	61.3	31
			Other	42.9	57.1	14
		Other	Big City	55.7	44.3	115
			Suburb	54.0	46.0	50
			Other	0.0 *	0.0	0
	Mixed	Mixed	Big City	46.4	53.6	125
			Suburb	49.3	50.7	134
			Other	48.6	51.4	218
		ProfSkil	Big City	47.6	52.4	124
			Suburb	48.8	51.2	41
			Other	0.0 *	0.0	0
		Other	Big City	53.7	46.3	54
			Suburb	59.3	40.7	27
			Other	55.5	44.5	119
	White	Mixed	Big City	65.2	34.8	66
			Suburb	44.9	55.1	136
			Other	51.9	48.1	318
		ProfSkil	Big City	49.9	50.1	493
			Suburb	49.8	50.2	1030
			Other	51.2	48.8	254
		Other	Big City	45.8	54.2	107
			Suburb	50.3	49.7	157
			Other	50.6	49.4	316

TABLE 21

Multivariate Model of Math as a Discipline Attitude with Location Demographics

Model	Terms	d.f.	L.R.X^2	CMPD
H1	CTRS,D.	48	53.84	n.s.
H2	CTRS,DS,DT,DR,DC.	41	34.82	.353
H3	Difference due to DS.	1	12.60	.234
H4	Difference due to DT.	2	2.65	.049
H5	Difference due to DR.	2	1.48	.027
H6	Difference due to DC.	2	0.62	.012

Legend:
D = Math as a Discipline Attitude.
C = Community location.
T = Occupational typology of community.
R = School racial balance.
S = Size of school.
d.f. = Degrees of Freedom.
L.R.X^2 = Likelihood-Ratio Chi-Square.
CMPD = Coefficient of Multiple-Partial Determination.

3. MATHEMATICS ACHIEVEMENT

The analysis of mathematics achievement was done using the ANOVA procedure in SPSS-X. The dependent variable used was the percentile ranking of the individual's mathematics achievement score. The independent variables used were the gender, age, parents' education, race, location of community, type of community, racial balance of the school, and size of school.

The percentile ranking on achievement was calculated using the percentage correct score. Using the documentation supplied by NAEP, the exercise items were recoded into "correct," "incorrect," or "missing." The achievement of the respondent for each individual booklet was computer-calculated by dividing the number

of correct responses by the total number of exercises attempted in the booklet. Exercises coded as "missing" were not included in the achievement score calculation.

Percentage scores were comparable among students who took the same exercise booklet, but not among students who took different exercise booklets as both the number of items and the level of difficulty vary from booklet to booklet. The percentage scores were then converted to percentile ranking for each assessment package. This then allowed comparison of achievement among students who responded to different booklets since scores based on percentile ranks are comparable (Mullis, 1979).

The means for percentile rankings for the main effects on mathematics achievement are shown in Table 22. There appear to be significant differences among most of the independent variable categories.

TABLE 22

Mean Percentile Ranking on Math Achievement for Main Effects

Group	Mean	Std. Dev.	N
Total Population	51.4376	28.9111	8002
Parents' Education			
H.S. grad or less	42.7056	27.2328	3994
Post high school	60.1373	27.8971	4008
Age			
13 years old	51.3887	28.8926	3895
17 years old	51.4838	28.9320	4107
School Racial Balance			
Mostly non-white	30.9203	26.9111	582
Mixed	44.1466	29.0198	1455
Mostly white	55.2171	27.8772	5965
Gender			
Male	52.5751	29.6927	3936
Female	50.3365	28.0937	4066
Race			
White	55.5500	27.6017	6575
Black	28.3340	24.3652	893
Other	39.4305	30.1605	534
Location of Community			
Big city	51.1740	30.1384	1846
Suburbs	56.3085	28.3183	2337
Other	48.5853	28.2726	3820
Size of School			
Less than 900	50.7192	28.3223	3961
900 or more	52.1415	29.4632	4041
Occupational Typology of Community			
Mixed	46.9932	28.9416	2325
Professional-Skilled	57.8672	27.8984	3475
UnSkilled-Farm- Unem	45.9839	28.4546	2202

MAIN EFFECTS ANALYSIS FOR MATH ACHIEVEMENT

The analysis of variance confirmed that five of the main effects were significantly different at or beyond the .05 level.

Only the effects of size of school and age of the student were not significant. The strongest effects appeared to be those of parents' education and race of the student (see Table 23).

TABLE 23

Main Effects for Analysis of Variance for Math Achievement

Source of Variation	df	F	Sign. of F
Main Effects	12	165.329	0.000
Parents' Education	1	583.961	0.000
Race	2	220.676	0.000
School Racial Balance	2	28.918	0.000
Occupational Typology of Community	2	20.124	0.000
Location of Community	2	8.222	0.000
Gender	1	11.077	0.001
Size of School	1	1.286	0.257
Age	1	0.595	0.441

INTERACTION EFFECTS ON MATH ACHIEVEMENT

The mean percentile rankings on math achievement for all significant two-way interactions are shown in Table 24.

The analysis of variance for all two-way interactions is shown in Table 25. There were 11 significant two-way interaction effects identified. The strongest interaction effects appear to be those of parents' education with race and age with community location.

TABLE 24

Mean Percentile Ranking on Math Achievement for Significant Interaction Effects

Group	Mean	Std. Dev.	N
Total Population	51.4376	28.9111	8002
Parents' Education and Race			
H.S. grad or less	42.7056	27.2328	3994
White	47.2417	26.8014	3110
Black	24.9587	21.3780	553
Other	29.6928	23.4569	330
Post high school	60.1373	27.8971	4008
White	63.0095	26.1439	3464
Black	33.8279	27.7346	340
Other	55.1742	33.0634	204
Age and Location of Community			
13 years old	51.3887	28.8926	3895
Big city	54.5791	30.0991	1022
Suburbs	58.2675	27.6591	983
Other	46.0840	27.8414	1889
17 years old	51.4838	28.9320	4107
Big city	46.9451	29.6655	823
Suburbs	54.8863	28.7140	1354
Other	51.0334	28.4835	1930
Location of Community and School Racial Balance			
Big city	51.1740	30.1384	1846
Mostly non-white	32.0416	27.3889	312
Mixed	51.7350	31.8067	410
Mostly white	56.2930	28.0689	1123
Suburbs	56.3085	28.3183	2337
Mostly non-white	28.6931	28.0300	107
Mixed	42.3711	26.9351	277
Mostly white	59.7999	27.0698	1953
Other	48.5853	28.2726	3820
Mostly non-white	30.2341	25.2257	162
Mixed	40.7312	27.4255	768
Mostly white	51.7023	27.8655	2890

(continued on next page)

TABLE 24

Mean Percentile Ranking on Math Achievement for Significant Interaction Effects

Group	Mean	Std. Dev.	N
Occupational Typology and Location of Community			
Mixed	46.9932	28.9416	2325
Big city	45.9968	30.9315	453
Suburbs	49.2333	27.5811	380
Other	46.7255	28.6444	1492
Professional-Skilled	57.8672	27.8984	3475
Big city	58.3913	27.9998	1069
Suburbs	59.6297	27.7586	1631
Other	53.4357	27.6097	775
Unskilled-Farm- Unem	45.9839	28.4546	2202
Big city	34.5932	27.7772	324
Suburbs	47.9300	28.7765	326
Other	47.9510	27.9828	1553
Location of Community and Size of School			
Big city	51.1740	30.1384	1846
Less than 900	52.7962	27.9527	657
900 or more	50.2773	31.2563	1189
Suburbs	56.3085	28.3183	2337
Less than 900	58.2439	28.3148	732
900 or more	55.4258	28.2848	1605
Other	48.5853	28.2726	3820
Less than 900	48.0471	27.9972	2572
900 or more	49.6942	28.8114	1248
Gender and School Racial Balance			
Male	52.5751	29.6927	3936
Mostly non-white	30.8931	27.2114	293
Mixed	43.9846	29.5464	727
Mostly white	56.8970	28.5342	2915
Female	50.3365	28.0937	4066
Mostly non-white	30.9480	26.6504	289
Mixed	44.3086	28.5028	727
Mostly white	53.6113	27.1420	3050
Age and School Racial Balance			
13 years old	51.3887	28.8926	3895
Mostly non-white	33.9641	27.0132	313
Mixed	46.8802	29.6756	721
Mostly white	54.4330	28.0649	2861
17 years old	51.4838	28.9320	4107
Mostly non-white	27.3706	26.4006	269
Mixed	41.4628	28.1239	734
Mostly white	55.9396	27.6880	3105

(continued on next page)

TABLE 24

Mean Percentile Ranking on Math Achievement for Significant Interaction Effects

Group	Mean	Std. Dev.	N
Age and Occupational Typology			
13 years old	51.3887	28.8926	3895
Mixed	46.4496	29.0333	1300
Professional-Skilled	59.5999	27.7050	1679
Unskilled-Farm- Unem	43.3456	26.9287	916
17 years old	51.4838	28.9320	4107
Mixed	47.6827	28.8242	1025
Professional-Skilled	56.2473	27.9888	1796
Unskilled-Farm- Unem	47.8618	29.3589	1287
Age and Race			
13 years old	51.3887	28.8926	3895
White	54.9265	27.9210	3181
Black	32.0078	25.2514	434
Other	41.2185	30.7430	280
17 years old	51.4838	28.9320	4107
White	56.1344	27.2902	3394
Black	24.8644	22.9913	459
Other	37.4589	29.4392	254
Gender and Age			
Male	52.5751	29.6927	3936
13 years old	51.5439	29.7905	1966
17 years old	53.6044	29.5664	1970
Female	50.3365	28.0937	4066
13 years old	51.2305	27.9544	1928
17 years old	49.5300	28.2010	2138
Gender and Parents' Education			
Male	52.5751	29.6927	3936
H.S. grad or less	42.8766	27.9266	1937
Post high school	61.9754	28.3037	1999
Female	50.3365	28.0937	4066
H.S. grad or less	42.5445	26.5685	2056
Post high school	58.3094	27.3716	2010

TABLE 25

Interaction Effects for Analysis of Variance for Math Achievement

Source of Variation		df	F	Sign. of F
2-way Interactions		62	4.474	0.000
Gender	X Age	1	4.055	0.044
Gender	X Parents' Educ	1	3.741	0.053
Gender	X Race	2	1.010	0.364
Gender	X Occup of Comm	2	2.170	0.114
Gender	X Comm location	2	0.223	0.800
Gender	X School Race	2	4.958	0.007
Gender	X Size of School	1	3.192	0.074
Age	X Parents' Educ	1	0.001	1.000
Age	X Race	2	3.580	0.028
Age	X Occup of Comm	2	4.064	0.017
Age	X Comm location	2	10.232	0.000
Age	X School Race	2	4.154	0.016
Age	X Size of School	1	0.111	0.739
Parents' Educ	X Race	2	10.725	0.000
Parents' Educ	X Occup of Comm	2	2.085	0.125
Parents' Educ	X Comm location	2	0.502	0.605
Parents' Educ	X School Race	2	0.506	0.603
Parents' Educ	X Size of School	1	0.111	0.739
Race	X Occup of Comm	4	2.014	0.090
Race	X Comm location	4	2.052	0.085
Race	X School Race	4	1.961	0.098
Race	X Size of School	2	0.206	0.814
Occup of Comm	X Comm location	4	4.331	0.002
Occup of Comm	X School Race	4	1.992	0.093
Occup of Comm	X Size of School	2	0.813	0.444
Comm location	X School Race	4	4.967	0.001
Comm location	X Size of School	2	5.981	0.003
School Race	X Size of School	2	1.059	0.347

Examination of the mean percentile rankings among the interaction effect of race with parents' education showed that white students who came from homes where at least one parent had some post-high-school education scored in the highest percentile. The next highest ranking was among students classified as "other" on race who also had at least one parent with post-high school education. The lowest ranking on achievement was among black students who came from homes where the highest educational level of the parents was a high school diploma or less.

The interaction effect of age and location of community showed that students in both age groups were more likely to be ranked higher on math achievement if they lived in suburban areas. The younger students were less likely to be ranked high if they lived in areas outside big cities or suburbs. Older students were less likely to be ranked higher on math achievement if they lived in big cities.

Students who attended schools that were predominantly white in racial composition were more likely to be ranked higher on math achievement if they lived in big cities or suburban areas. Those who attended racially mixed schools in big cities were next most likely to be high on math achievement. Those who attended schools that were predominantly non-white in the suburbs were the least likely to be ranked high on math achievement.

As might be expected, students who lived in suburban areas in which the majority of the adults were employed in professional or technical occupations were the most likely to be ranked higher

on math achievement. Students who lived in communities in which the majority of adults were either employed in unskilled or farm occupations or were unemployed or on welfare were more likely to be ranked higher on math achievement if they lived in areas outside big cities and suburbs.

Students who attended small schools were more likely to be higher on math achievement if those schools were in the big cities or suburbs. Those attending small schools outside big cities and suburbs were least likely to be ranked high on math achievement.

Males who attended mostly white schools were more likely to be higher on math achievement and least likely to be higher on math achievement if they attended non-white schools. The same was true for the female students. However, females who attended racially mixed schools were more likely to be ranked higher than were males who attended those schools.

Thirteen-year-olds who attended schools that were racially mixed or predominantly non-white were more likely to be ranked higher on math achievement than were the 17-year-olds who attended the same types of schools.

Both the 13-year-olds and 17-year-olds were more likely to be ranked higher on math achievement if they lived in communities in which the majority of adults were employed in professional or technical occupations. Among those students living in communities in which there was no dominant occupational category, the younger students were more likely to be ranked higher on achieve-

ment and the older ones were more likely to be ranked lower on achievement.

White 17-year-olds were most likely to be ranked higher on math achievement while black 17-year-olds were least likely to be so ranked. Thirteen-year-olds who were white or classified as "other" on race were more likely to score higher on math achievement than were the 17-year-olds from the same racial groups.

Confirming much of the previous research, females and males showed little difference in math achievement at age 13, but did show differences at age 17.

Both males and females were more likely to be ranked higher on math achievement if they lived in homes in which at least one parent had some post-high-school education.

4. MATH ATTITUDE INDEX

The final step in this analysis was an analysis of variance using the previously identified independent variables and the Math Attitude Index. The Math Attitude Index was created by summing the values for the responses for the 14 items on the math attitude question included in the test booklets. The range of values on this scale went from 0 to 70.

MAIN EFFECTS ANALYSIS FOR MATH ATTITUDE INDEX

The mean ranking on the Math Attitude Index for the main effects is shown in Table 26.

The analysis of variance confirmed that five of the main effects were significantly different at or beyond the .05 level.

Only the effects of the size of school and the occupational typology of the community were not significant. The strongest effect appeared to be that of parents' education. This was also the strongest effect in the analysis of variance for math achievement.

TABLE 26

Mean Ranking on Math Attitude Index for Main Effects

Group	Mean	Std. Dev.	N
Total Population	44.4721	9.9652	8002
Gender			
Male	44.7867	10.1264	3936
Female	44.1675	9.7982	4066
Age			
13 years old	44.9419	9.4694	3895
17 years old	44.0266	10.3950	4107
Parents' Education			
H.S. grad or less	43.2815	9.6149	3994
Post high school	45.6582	10.1657	4008
Race			
White	44.4430	9.9759	6575
Black	45.1908	9.4758	893
Other	43.6300	10.5526	534
Occupational Typology of Community			
Mixed	44.6960	9.7276	2325
Professional-Skilled	44.5437	10.1508	3475
Unskilled-Farm- Unem	44.1227	9.9124	2202
Location of Community			
Big city	44.8964	10.1155	1846
Suburbs	44.1033	10.2296	2337
Other	44.4926	9.7191	3820
School Racial Balance			
Mostly non-white	44.4843	9.0704	582
Mixed	45.3413	10.0339	1455
Mostly white	44.2590	10.0216	5965
Size of School			
Less than 900	44.5299	9.5724	3961
900 or more	44.4154	10.3365	4041

TABLE 27

Main Effects for Analysis of Variance for Math Attitude Index

Source of Variation	df	F	Sign. of F
Main Effects	12	14.708	0.000
Parents' Education	1	120.498	0.000
Age	1	14.764	0.000
School Racial Balance	2	5.434	0.004
Gender	1	6.642	0.010
Race	2	4.027	0.018
Location of Community	2	3.136	0.044
Size of School	1	1.017	0.313
Occupational Typology of Community	2	0.162	0.850

INTERACTION EFFECTS ON MATH ATTITUDE INDEX

There were four significant two-way interaction effects identified in the analysis of variance for math attitudes. The strongest effect appeared to be that of community location and size of school. Next strongest was community location and age of the student (see Table 29).

The mean ranking on the Math Attitude Index for the significant interaction effects is displayed in Table 28. Students who live outside the big cities were more likely to have a positive attitude toward math if they attended small schools than if they attended large ones. Those who lived in big cities were more likely to have a positive math attitude if they attended a large school.

The younger students in big cities had the most positive attitudes toward math. Older students in the suburbs had the least positive attitude.

Students attending small schools were more likely to have a positive attitude toward math if they were younger than if they were older.

Those students who came from homes in which at least one parent had some post-high-school education and who were classified as "other" on race were the most likely to have a positive attitude toward math. Students who were classified as "other" on race but who came from homes in which the highest educational level of the parents was a high school diploma or less were the least likely to have a positive attitude toward math.

TABLE 28

Mean Ranking on Math Attitude Index for Significant Interaction Effects

Group	Mean	Std. Dev.	N
Total Population	44.4721	9.9652	8002
Community Location and Size of School			
Big city	44.8964	10.1155	1846
Less than 900	44.4985	10.0150	657
900 or more	45.1164	10.1682	1189
Suburbs	44.1033	10.2296	2337
Less than 900	44.1799	9.6908	732
900 or more	44.0684	10.4689	1605
Other	44.4926	9.7191	3820
Less than 900	44.6376	9.4232	2572
900 or more	44.1939	10.2997	1248
Age and Community Location			
13 years old	44.9419	9.4694	3895
Big city	45.7142	9.8497	1022
Suburbs	44.4906	9.6894	983
Other	44.7587	9.1180	1889
17 years old	44.0266	10.3950	4107
Big city	43.8808	10.3526	823
Suburbs	43.8221	10.5992	1354
Other	44.2322	10.2691	1930
Age and Size of School			
13 years old	44.9419	9.4694	3895
Less than 900	44.8334	9.3872	2826
900 or more	45.2287	9.6821	1069
17 years old	44.0266	10.3950	4107
Less than 900	43.7742	9.9830	1135
900 or more	44.1230	10.5481	2973
Parents' Education and Race			
H.S. grad or less	43.2815	9.6149	3994
White	43.1289	9.6556	3110
Black	44.8454	9.2110	553
Other	42.1005	9.6245	330
Post high school	45.6582	10.1657	4008
White	45.6228	10.1119	3464
Black	45.7529	9.8797	340
Other	46.1027	11.5018	204

TABLE 29

Interaction Effects for Analysis of Variance for Math Attitude Index

Source of Variation		df	F	Sign. of F
2-way Interactions		62	1.842	0.000
Gender	X Age	1	0.430	0.512
Gender	X Parents' Educ	1	1.984	0.159
Gender	X Race	2	1.098	0.334
Gender	X Occup of Comm	2	0.267	0.766
Gender	X Comm location	2	1.722	0.179
Gender	X School Race	2	1.809	0.164
Gender	X Size of School	1	0.479	0.489
Age	X Parents' Educ	1	3.195	0.074
Age	X Race	2	1.841	0.159
Age	X Occup of Comm	2	0.563	0.570
Age	X Comm location	2	5.247	0.005
Age	X School Race	2	1.984	0.138
Age	X Size of School	1	5.332	0.021
Parents' Educ	X Race	2	3.135	0.044
Parents' Educ	X Occup of Comm	2	0.910	0.403
Parents' Educ	X Comm location	2	1.564	0.210
Parents' Educ	X School Race	2	0.189	0.828
Parents' Educ	X Size of School	1	0.160	0.689
Race	X Occup of Comm	4	1.688	0.150
Race	X Comm location	4	1.653	0.158
Race	X School Race	4	1.585	0.176
Race	X Size of School	2	0.367	0.693
Occup of Comm	X Comm location	4	1.439	0.219
Occup of Comm	X School Race	4	0.837	0.502
Occup of Comm	X Size of School	2	1.809	0.164
Comm location	X School Race	4	0.572	0.683
Comm location	X Size of School	2	6.109	0.002
School Race	X Size of School	2	1.735	0.177

5. SUMMARY

Much of this analysis has confirmed previous research findings. There are apparent gender differences in both attitudes toward mathematics and achievement in mathematics. While these differences are statistically significant when examined in bivariate relationships, they are much less significant when examined in a multivariate context.

The biggest gender differences in responses to the 14 individual math attitude items were to the following statements:

I am good at mathematics.

Creative people have trouble with math.

Mathematics is more for boys than girls.

Only 57% of the females agreed with the first statement, while 67% of the males agreed. Twenty-five percent of the females indicated they were unsure of a response to this statement and only 21% of the males indicated uncertainty.

The statement about creative people and math had a large proportion of students who indicated uncertainty in their response. Thirty-five percent of the males and 29% of the females gave uncertain responses to this item. This was the highest proportion of uncertainty for any of the 14 statements. Females had 13% in agreement with the statement and males had 9% in agreement.

While there was not much difference in the proportion agreeing with the statement about math being a male domain (males had 3% in agreement and females had 2% in agreement), there were big-

ger differences in those who disagreed and those who were uncertain. Nine percent of the males were uncertain and the remaining 88% of males disagreed with the statement. Ninety-five percent of the females disagreed with the statment, which indicated that these girls do not perceive math as a male domain.

There were no significant gender differences in any of the three math attitude scales constructed: Math and Oneself(MOAS), Math and Society(MSAS), and Math as a Discipline(MDAS). The strongest predictor of a positive attitude on each of these scales was age. Younger students were more likely to be positive on the MOAS and the MSAS, while older students were more likely to be positive on the MDAS. Students who come from homes where parents have higher levels of formal education are more likely to be positive on the MOAS and MDAS. Black students are more likely to be positive on the MSAS.

The personal demographic variables seemed to have greater predictive power than did the location demographic variables in the ability to predict positive attitudes on the three attitude scales. The only model identified using the location demographic variables that had predictive power was the one for MSAS where the size and racial balance of the school plus their interaction accounted for 68% of the variation in the model. Students from small schools that were predominantly white were most likely to have a positive attitude on this scale followed by those who attended large schools that were predominantly non-white.

Of the five significant influences identified in the analysis of variance on math achievement, gender appeared to have the least influence. The level of parent education seemed to have the greatest influence as did the race of the student. There were two significant two-way interactions with gender. The first was gender with the racial balance of the school. The second was the interaction of gender with age. However, there were other interactions that seemed to have more influence. It seems that while gender differences in math achievement do exist, much of the difference appears to be due to other influences.

The overall Math Attitude Index analysis showed that parent education, the age of the student, and the racial balance of the school all had more influence than did gender.

Among the personal demographic and location demographic variables included in this analysis of both mathematics achievement and attitudes toward math, the strongest influence identified was that of the level of education of the parents. Students who came from homes in which at least one parent had some education beyond a high-school diploma were more likely to have higher achievement scores and a more positive attitude toward mathematics.

White students were more likely to have higher mathematics achievement scores. Black students were more likely to have lower mathematics achievement scores, and those of other racial groups were more likely to be ranked in between the whites and blacks on mathematics achievement.

What does all this mean for practical purposes? Many of the influences identified in this analysis are things over which the schools have no control. What the schools can do is to continue to be aware of these influences and try to develop innovative ways to stimulate both the development of positive attitudes toward mathematics and higher achievement in mathematics. Extra efforts will need to be made with those students who have been identified as being members of some of the subpopulations that have negative attitudes and lower achievement scores.

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Appendix A

BIVARIATE DISTRIBUTIONS FOR MATH ATTITUDE ITEMS

I am good at mathematics

	Not Sure	Disagree	Agree	N
TOTAL	24%	14%	62%	8002
SEX*				
Male	21%	11%	67%	3936
Female	26%	17%	57%	4066
AGE OF RESPONDENT*				
13 years old	23%	9%	68%	3895
17 years old	25%	19%	56%	4107
RACE*				
White	24%	14%	62%	6575
Black	23%	13%	64%	893
Other	32%	12%	56%	534
PARENTS EDUCATION*				
H.S. grad or less	26%	16%	58%	3994
Post high school	22%	12%	66%	4008
COMMUNITY SIZE*				
Big city	24%	14%	62%	1846
Suburbs	22%	16%	62%	2337
Other	25%	13%	61%	3820
TYPE OF COMMUNITY*				
Mixed	24%	13%	63%	2325
Professional-Skilled	23%	15%	62%	3475
Unskilled-Farm-Unemp loyed-Welfare	26%	15%	60%	2202
SIZE OF SCHOOL*				
Less than 900	24%	12%	64%	3961
900 or more	24%	16%	60%	4041
RACIAL COMPOSITION OF SCHOOL				
Mostly non-white	24%	14%	62%	582
Mixed	24%	13%	63%	1455
Mostly white	24%	15%	61%	5965

* = $p < .05$

Math helps a person think logically

	Not Sure	Disagree	Agree	N
TOTAL	17%	7%	76%	8002
SEX				
Male	16%	7%	77%	3936
Female	18%	7%	76%	4066
AGE OF RESPONDENT*				
13 years old	19%	6%	74%	3895
17 years old	15%	7%	78%	4107
RACE				
White	17%	7%	76%	6575
Black	17%	7%	76%	893
Other	15%	6%	79%	534
PARENTS EDUCATION*				
H.S. grad or less	19%	8%	74%	3994
Post high school	16%	6%	79%	4008
COMMUNITY SIZE*				
Big city	15%	8%	77%	1846
Suburbs	18%	7%	75%	2337
Other	18%	6%	76%	3820
TYPE OF COMMUNITY				
Mixed	18%	6%	76%	2325
Professional-Skilled	16%	7%	77%	3475
Unskilled-Farm-Unemp loyed-Welfare	18%	7%	75%	2202
SIZE OF SCHOOL*				
Less than 900	19%	6%	76%	3961
900 or more	16%	8%	77%	4041
RACIAL COMPOSITION OF SCHOOL				
Mostly non-white	16%	8%	76%	582
Mixed	16%	6%	79%	1455
Mostly white	18%	7%	75%	5965

* = $p < .05$

It is important to know math to get a good job

	Not Sure	Disagree	Agree	N
TOTAL	18%	23%	59%	8002
SEX*				
Male	17%	22%	61%	3936
Female	19%	24%	57%	4066
AGE OF RESPONDENT*				
13 years old	15%	14%	71%	3895
17 years old	20%	32%	48%	4107
RACE*				
White	19%	24%	57%	6575
Black	12%	19%	69%	893
Other	16%	16%	68%	534
PARENTS EDUCATION				
H.S. grad or less	17%	24%	59%	3994
Post high school	18%	22%	60%	4008
COMMUNITY SIZE*				
Big city	16%	21%	63%	1846
Suburbs	19%	27%	54%	2337
Other	18%	21%	61%	3820
TYPE OF COMMUNITY*				
Mixed	16%	21%	63%	2325
Professional-Skilled	19%	25%	57%	3475
Unskilled-Farm-Unemployed-Welfare	18%	22%	59%	2202
SIZE OF SCHOOL*				
Less than 900	17%	18%	65%	3961
900 or more	19%	28%	54%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	12%	16%	71%	582
Mixed	17%	21%	62%	1455
Mostly white	19%	24%	57%	5965

* = $p < .05$

It is important to know arithmetic to get a good job

	Not Sure	Disagree	Agree	N
TOTAL	8%	7%	85%	8002
SEX*				
Male	8%	8%	84%	3936
Female	8%	6%	87%	4066
AGE OF RESPONDENT*				
13 years old	9%	6%	85%	3895
17 years old	7%	7%	86%	4107
RACE*				
White	7%	7%	86%	6575
Black	10%	8%	82%	893
Other	11%	6%	82%	534
PARENTS EDUCATION*				
H.S. grad or less	9%	8%	83%	3994
Post high school	7%	6%	87%	4008
COMMUNITY SIZE*				
Big city	9%	8%	82%	1846
Suburbs	7%	7%	85%	2337
Other	7%	6%	87%	3820
TYPE OF COMMUNITY				
Mixed	9%	7%	85%	2325
Professional-Skilled	8%	7%	85%	3475
Unskilled-Farm-Unemployed-Welfare	7%	7%	86%	2202
SIZE OF SCHOOL				
Less than 900	8%	6%	86%	3961
900 or more	8%	7%	85%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	8%	11%	81%	582
Mixed	8%	6%	86%	1455
Mostly white	8%	7%	86%	5965

* = $p < .05$

I am taking math only because I have to

	Not Sure	Agree	Disagree	N
TOTAL	11%	26%	63%	8002
SEX				
Male	12%	26%	63%	3936
Female	11%	26%	63%	4066
AGE OF RESPONDENT*				
13 years old	12%	27%	61%	3895
17 years old	10%	26%	64%	4107
RACE*				
White	12%	25%	63%	6575
Black	9%	33%	59%	893
Other	12%	26%	62%	534
PARENTS EDUCATION*				
H.S. grad or less	11%	30%	59%	3994
Post high school	11%	23%	66%	4008
COMMUNITY SIZE				
Big city	12%	28%	61%	1846
Suburbs	12%	26%	62%	2337
Other	11%	25%	64%	3820
TYPE OF COMMUNITY				
Mixed	11%	26%	64%	2325
Professional-Skilled	12%	26%	62%	3475
Unskilled-Farm-Unemp loyed-Welfare	11%	27%	63%	2202
SIZE OF SCHOOL				
Less than 900	11%	26%	62%	3961
900 or more	11%	26%	63%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	10%	32%	57%	582
Mixed	10%	24%	65%	1455
Mostly white	12%	26%	63%	5965

* = p <.05

New discoveries are seldom made in math

	Not Sure	Agree	Disagree	N
TOTAL	26%	26%	48%	8002
SEX*				
Male	24%	27%	49%	3936
Female	28%	25%	47%	4066
AGE OF RESPONDENT*				
13 years old	25%	32%	44%	3895
17 years old	28%	20%	52%	4107
RACE*				
White	26%	23%	51%	6575
Black	23%	42%	35%	893
Other	30%	36%	34%	534
PARENTS EDUCATION*				
H.S. grad or less	27%	31%	43%	3994
Post high school	26%	21%	53%	4008
COMMUNITY SIZE				
Big city	27%	26%	47%	1846
Suburbs	28%	25%	47%	2337
Other	25%	26%	49%	3820
TYPE OF COMMUNITY*				
Mixed	25%	28%	47%	2325
Professional-Skilled	27%	24%	49%	3475
Unskilled-Farm-Unemp loyed-Welfare	25%	27%	48%	2202
SIZE OF SCHOOL*				
Less than 900	25%	28%	47%	3961
900 or more	27%	24%	49%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	26%	42%	32%	582
Mixed	25%	28%	47%	1455
Mostly white	26%	24%	50%	5965

* = $p < .05$

Mathematics is more for boys than for girls

	Not Sure	Agree	Disagree	N
TOTAL	6%	3%	91%	8002
SEX*				
Male	9%	3%	88%	3936
Female	3%	2%	95%	4066
AGE OF RESPONDENT				
13 years old	6%	3%	91%	3895
17 years old	6%	2%	92%	4107
RACE*				
White	6%	2%	92%	6575
Black	6%	4%	90%	893
Other	8%	3%	89%	534
PARENTS EDUCATION				
H.S. grad or less	6%	2%	91%	3994
Post high school	6%	3%	92%	4008
COMMUNITY SIZE*				
Big city	5%	3%	91%	1846
Suburbs	6%	2%	91%	2337
Other	6%	2%	92%	3820
TYPE OF COMMUNITY				
Mixed	6%	3%	92%	2325
Professional-Skilled	6%	3%	91%	3475
Unskilled-Farm-Unemp loyed-Welfare	6%	2%	92%	2202
SIZE OF SCHOOL				
Less than 900	6%	2%	92%	3961
900 or more	6%	3%	91%	4041
RACIAL COMPOSITION OF SCHOOL				
Mostly non-white	6%	3%	92%	582
Mixed	5%	3%	92%	1455
Mostly white	6%	2%	91%	5965

* = $p < .05$

I would like to take more mathematics

	Not Sure	Disagree	Agree	N
TOTAL	27%	29%	43%	8002
SEX*				
Male	26%	29%	45%	3936
Female	28%	30%	42%	4066
AGE OF RESPONDENT*				
13 years old	26%	27%	47%	3895
17 years old	28%	32%	40%	4107
RACE*				
White	28%	31%	41%	6575
Black	21%	23%	55%	893
Other	26%	22%	52%	534
PARENTS EDUCATION*				
H.S. grad or less	27%	31%	41%	3994
Post high school	27%	27%	45%	4008
COMMUNITY SIZE*				
Big city	26%	29%	45%	1846
Suburbs	27%	32%	41%	2337
Other	28%	28%	44%	3820
TYPE OF COMMUNITY*				
Mixed	25%	28%	47%	2325
Professional-Skilled	28%	31%	41%	3475
Unskilled-Farm-Unemp loyed-Welfare	28%	29%	43%	2202
SIZE OF SCHOOL				
Less than 900	28%	29%	44%	3961
900 or more	27%	30%	43%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	23%	22%	55%	582
Mixed	25%	26%	50%	1455
Mostly white	28%	31%	41%	5965

* = $p < .05$

Creative people have trouble with math

	Not Sure	Agree	Disagree	N
TOTAL	32%	11%	57%	8002
SEX*				
Male	35%	13%	52%	3936
Female	29%	9%	61%	4066
AGE OF RESPONDENT*				
13 years old	33%	13%	55%	3895
17 years old	32%	10%	59%	4107
RACE*				
White	33%	9%	58%	6575
Black	30%	22%	47%	893
Other	28%	19%	53%	534
PARENTS EDUCATION*				
H.S. grad or less	33%	14%	53%	3994
Post high school	31%	9%	61%	4008
COMMUNITY SIZE*				
Big city	30%	12%	58%	1846
Suburbs	32%	9%	60%	2337
Other	33%	12%	55%	3820
TYPE OF COMMUNITY*				
Mixed	33%	13%	55%	2325
Professional-Skilled	31%	9%	60%	3475
Unskilled-Farm-Unemp loyed-Welfare	33%	12%	55%	2202
SIZE OF SCHOOL*				
Less than 900	33%	12%	55%	3961
900 or more	31%	10%	58%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	30%	22%	48%	582
Mixed	32%	14%	55%	1455
Mostly white	32%	9%	58%	5965

* = $p < .05$

Estimating is an important math skill

	Not Sure	Disagree	Agree	N
TOTAL	17%	9%	73%	8002
SEX*				
Male	15%	10%	74%	3936
Female	19%	9%	72%	4066
AGE OF RESPONDENT				
13 years old	18%	9%	73%	3895
17 years old	17%	10%	73%	4107
RACE				
White	17%	10%	74%	6575
Black	19%	8%	73%	893
Other	21%	10%	69%	534
PARENTS EDUCATION				
H.S. grad or less	18%	10%	72%	3994
Post high school	17%	9%	74%	4008
COMMUNITY SIZE				
Big city	17%	10%	73%	1846
Suburbs	18%	10%	72%	2337
Other	17%	9%	74%	3820
TYPE OF COMMUNITY				
Mixed	17%	9%	73%	2325
Professional-Skilled	17%	10%	73%	3475
Unskilled-Farm-Unemp loyed-Welfare	18%	9%	73%	2202
SIZE OF SCHOOL				
Less than 900	18%	9%	73%	3961
900 or more	17%	10%	73%	4041
RACIAL COMPOSITION OF SCHOOL				
Mostly non-white	18%	8%	74%	582
Mixed	18%	8%	74%	1455
Mostly white	17%	10%	73%	5965

This was the only item that had no significant differences in any of the subpopulations examined.

I understand what we talk about in math

	Not Sure	Disagree	Agree	N
TOTAL	12%	14%	73%	8002
SEX*				
Male	12%	13%	76%	3936
Female	13%	16%	71%	4066
AGE OF RESPONDENT*				
13 years old	11%	10%	80%	3895
17 years old	14%	19%	68%	4107
RACE*				
White	12%	14%	74%	6575
Black	11%	14%	75%	893
Other	17%	16%	68%	534
PARENTS EDUCATION*				
H.S. grad or less	14%	16%	71%	3994
Post high school	11%	13%	76%	4008
COMMUNITY SIZE*				
Big city	13%	13%	74%	1846
Suburbs	11%	16%	73%	2337
Other	13%	14%	73%	3820
TYPE OF COMMUNITY*				
Mixed	13%	12%	75%	2325
Professional-Skilled	11%	14%	74%	3475
Unskilled-Farm-Unemp loyed-Welfare	13%	16%	71%	2202
SIZE OF SCHOOL*				
Less than 900	12%	12%	76%	3961
900 or more	13%	16%	71%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	15%	17%	68%	582
Mixed	12%	14%	74%	1455
Mostly white	12%	14%	74%	5965

* = p <.05

Trial and error can often solve math problems

	Not Sure	Disagree	Agree	N
TOTAL	26%	11%	63%	8002
SEX*				
Male	22%	13%	66%	3936
Female	29%	10%	61%	4066
AGE OF RESPONDENT*				
13 years old	33%	12%	55%	3895
17 years old	18%	10%	72%	4107
RACE*				
White	25%	11%	64%	6575
Black	26%	14%	60%	893
Other	29%	9%	62%	534
PARENTS EDUCATION*				
H.S. grad or less	27%	11%	61%	3994
Post high school	24%	11%	66%	4008
COMMUNITY SIZE				
Big city	27%	11%	62%	1846
Suburbs	24%	11%	65%	2337
Other	26%	11%	63%	3820
TYPE OF COMMUNITY*				
Mixed	27%	11%	62%	2325
Professional-Skilled	24%	12%	64%	3475
Unskilled-Farm-Unemployed-Welfare	27%	10%	63%	2202
SIZE OF SCHOOL*				
Less than 900	29%	11%	60%	3961
900 or more	22%	11%	67%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	29%	12%	58%	582
Mixed	25%	10%	65%	1455
Mostly white	25%	11%	63%	5965

* = $p < .05$

A good grade in math is important to me

	Not Sure	Disagree	Agree	N
TOTAL	5%	4%	91%	8002
SEX*				
Male	6%	4%	90%	3936
Female	4%	4%	92%	4066
AGE OF RESPONDENT*				
13 years old	2%	2%	96%	3895
17 years old	7%	6%	86%	4107
RACE*				
White	5%	4%	91%	6575
Black	1%	3%	96%	893
Other	5%	4%	91%	534
PARENTS EDUCATION*				
H.S. grad or less	5%	5%	91%	3994
Post high school	5%	4%	92%	4008
COMMUNITY SIZE*				
Big city	4%	3%	93%	1846
Suburbs	6%	5%	89%	2337
Other	5%	4%	92%	3820
TYPE OF COMMUNITY*				
Mixed	4%	3%	93%	2325
Professional-Skilled	6%	5%	90%	3475
Unskilled-Farm-Unemployed-Welfare	5%	4%	91%	2202
SIZE OF SCHOOL*				
Less than 900	3%	3%	94%	3961
900 or more	6%	5%	89%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	3%	4%	93%	582
Mixed	4%	3%	94%	1455
Mostly white	5%	4%	90%	5965

* = $p < .05$

Justifying math statements is important

	Not Sure	Disagree	Agree	N
TOTAL	29%	5%	66%	8002
SEX*				
Male	28%	5%	67%	3936
Female	30%	4%	66%	4066
AGE OF RESPONDENT*				
13 years old	31%	5%	64%	3895
17 years old	27%	5%	69%	4107
RACE*				
White	30%	5%	66%	6575
Black	23%	7%	70%	893
Other	27%	5%	68%	534
PARENTS EDUCATION				
H.S. grad or less	29%	5%	65%	3994
Post high school	28%	5%	67%	4008
COMMUNITY SIZE				
Big city	28%	6%	67%	1846
Suburbs	31%	5%	64%	2337
Other	28%	4%	67%	3820
TYPE OF COMMUNITY				
Mixed	28%	5%	67%	2325
Professional-Skilled	30%	5%	65%	3475
Unskilled-Farm-Unemp loyed-Welfare	28%	4%	68%	2202
SIZE OF SCHOOL*				
Less than 900	30%	5%	65%	3961
900 or more	27%	5%	67%	4041
RACIAL COMPOSITION OF SCHOOL*				
Mostly non-white	21%	7%	72%	582
Mixed	26%	6%	68%	1455
Mostly white	30%	5%	65%	5965

* = p <.05